US006574891B1

(12) **United States Patent**
Ireland et al.

(10) **Patent No.: US 6,574,891 B1**
(45) **Date of Patent: *Jun. 10, 2003**

(54) **EXCAVATION BUCKET INCORPORATING AN IMPACT ACTUATOR ASSEMBLY**

(75) Inventors: **Odin Ireland**, Montréal (CA); **Claude Cote**, Varennes (CA)

(73) Assignee: **3786111 Canada Inc.**, Ste-Julie (CA)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **09/623,749**

(22) PCT Filed: **Mar. 10, 1998**

(86) PCT No.: **PCT/CA98/00205**

§ 371 (c)(1),
(2), (4) Date: **Sep. 8, 2000**

(87) PCT Pub. No.: **WO99/46451**

PCT Pub. Date: **Sep. 16, 1999**

(51) **Int. Cl.**[7] **E02F 3/36**
(52) **U.S. Cl.** **37/447**; 37/403
(58) **Field of Search** 37/446, 403, 447, 37/444, 466, 906, 904

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,228,448 A		1/1941	de Velbiss	
3,113,390 A	*	12/1963	Pewthers	37/447
3,512,284 A	*	5/1970	Haynes	37/447
3,520,076 A	*	7/1970	Nichols	172/701.3
3,645,021 A	*	2/1972	Sonerud	173/203
3,659,730 A	*	5/1972	Butler	37/444
4,111,269 A	*	9/1978	Ottestad	173/170
4,132,017 A	*	1/1979	Robson et al.	37/447
4,625,438 A	*	12/1986	Mozer	37/414
4,892,359 A	*	1/1990	Ottestad	37/447
4,959,915 A	*	10/1990	Roussin et al.	172/40
5,065,326 A	*	11/1991	Sahm	340/686.1
5,065,824 A	*	11/1991	Ottestad	173/206
5,269,382 A	*	12/1993	Ottestad	173/128
5,353,532 A	*	10/1994	Lysenko et al.	172/101
5,408,768 A	*	4/1995	Karani	172/664
5,678,332 A	*	10/1997	Hawkins	37/403
5,727,639 A	*	3/1998	Jeter	173/126
6,032,093 A	*	2/2000	Denbraber et al.	37/348

FOREIGN PATENT DOCUMENTS

FR	2 277 943	2/1976
GB	2 220 962	1/1990
WO	WO 90/10756	9/1990
WO	WO 93/23210	11/1993

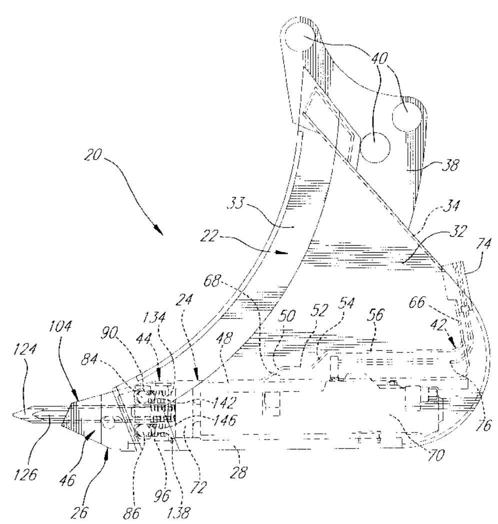
* cited by examiner

Primary Examiner—Thomas B. Will
Assistant Examiner—Kristine Florio
(74) *Attorney, Agent, or Firm*—Eric Fincham

(57) **ABSTRACT**

An excavation bucket incorporating an impact actuator assembly is described herein. The excavation bucket includes a bucket body, a movable head, a movable floor portion mounted to the movable head and an impact actuator provided between and mounted to the bucket body and the movable head. The movable head is longitudinally movable in the bucket body. The movable head is provided with tools, such as teeth, to penetrate hard soils. These tools are slidably mounted in the movable head to reach a retracted position when they are pushed against hard soil. When the impact actuator is activated, the longitudinal impacts generated by the impact actuator drive the tools into the hard soil if the tools are in their retracted positions. However, if the impact actuator is activated while the tools are not in their retracted position, the longitudinal impacts will cause the repetitive longitudinal movements of the movable head and thus of the movable floor with respect to the bucket body.

38 Claims, 18 Drawing Sheets



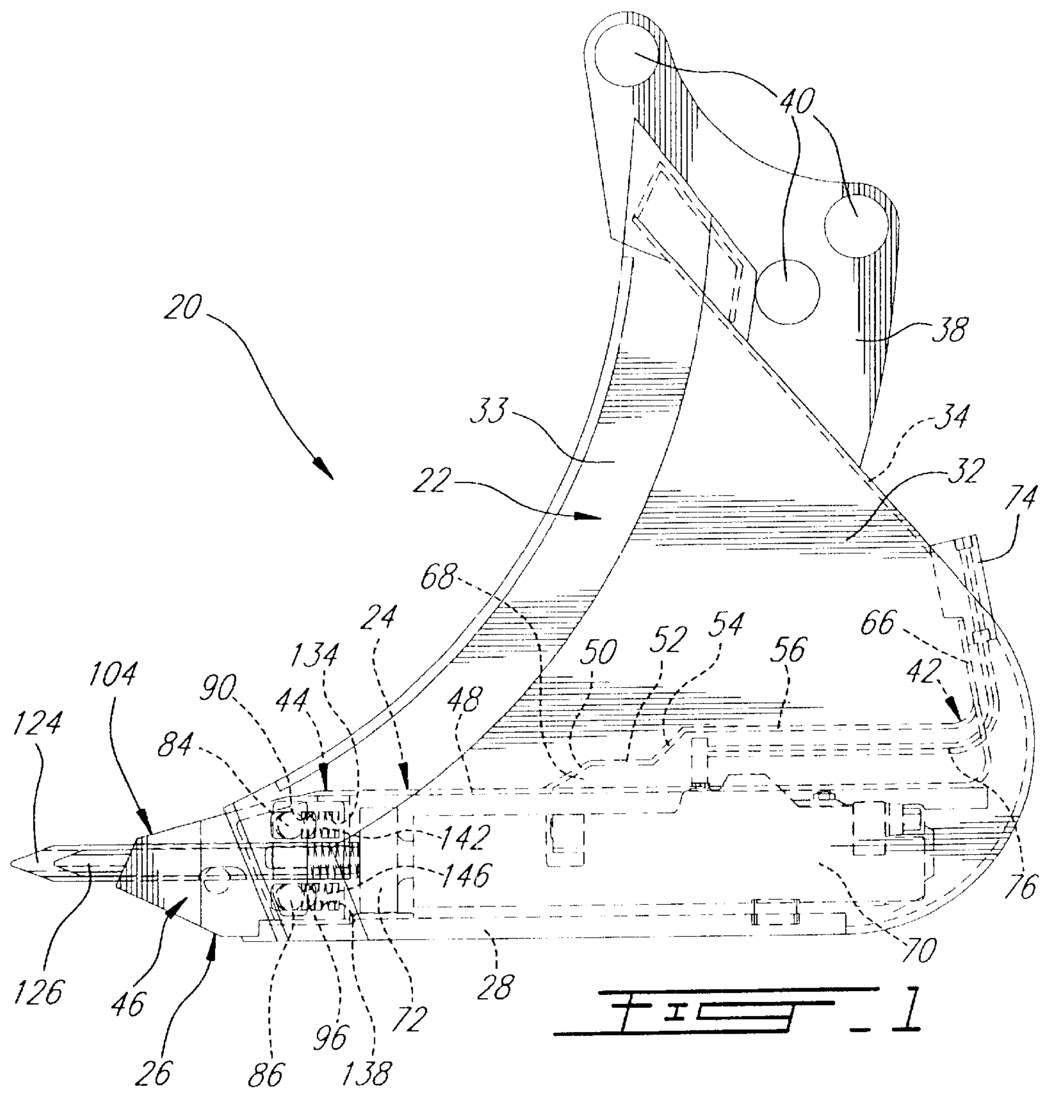

40
38
34
32
74
33
22
20
68
24
134
44
48
50
52
54
56
66
42
104
90
84
124
142
146
76
70
126
46
26
86
96
138
72
28

FIG. 1

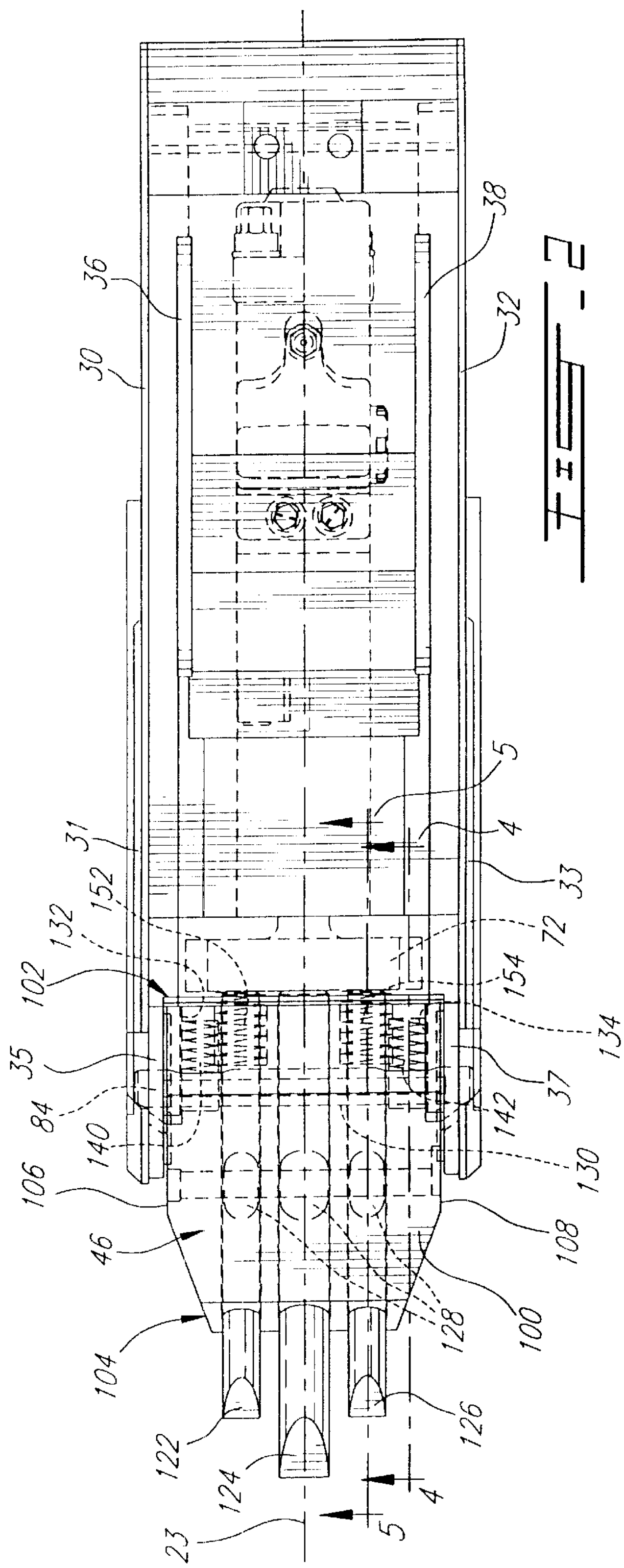

36
38
30
32
31
33
5
4
152
132
72
102
154
134
35
37
84
142
140
130
106
108
46
100
128
104
126
122
124
23
4
5

FIG. 2

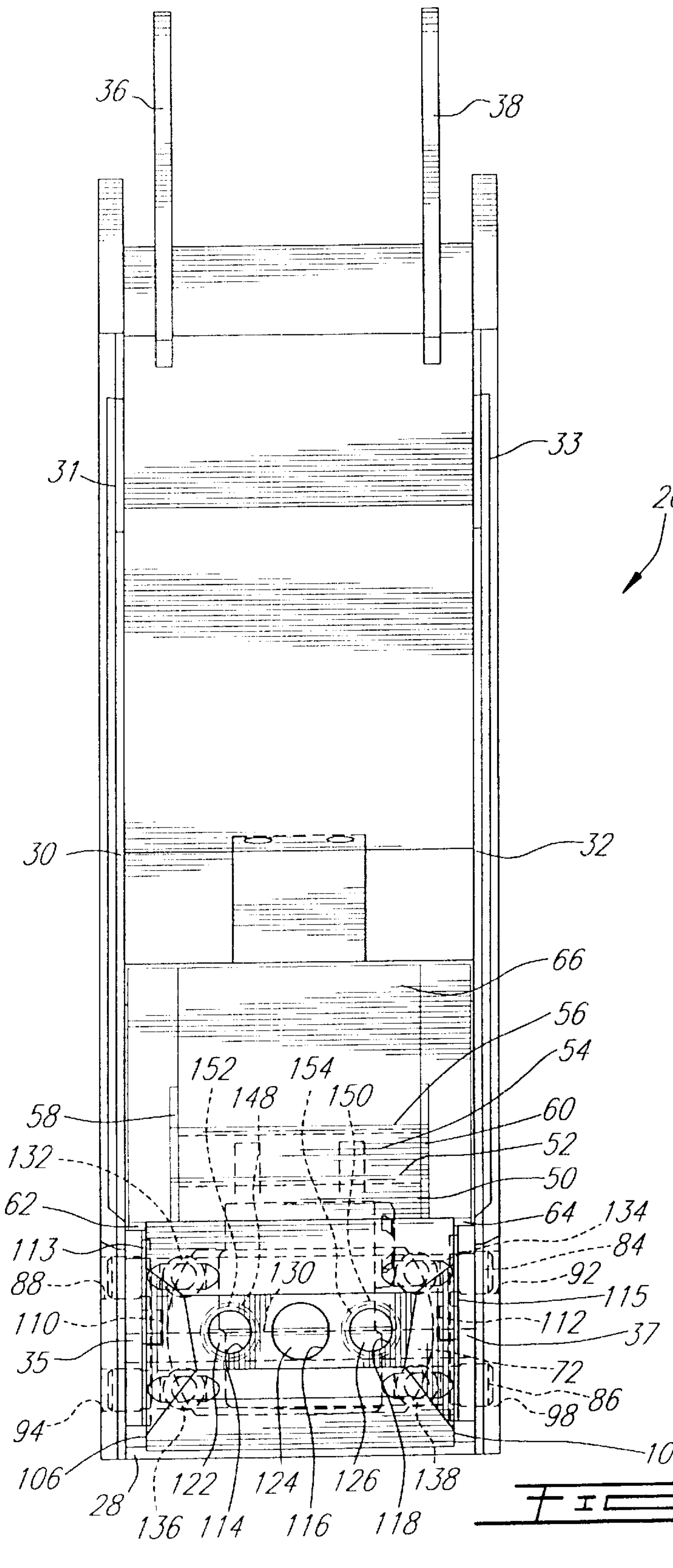

36
38
31
33
20
30
32
66
56
54
152
154
148
150
58
60
52
132
50
62
64
134
113
84
92
88
130
115
110
112
35
37
72
86
94
98
108
106
122
124
126
138
28
136
114
116
118

FIG. 3

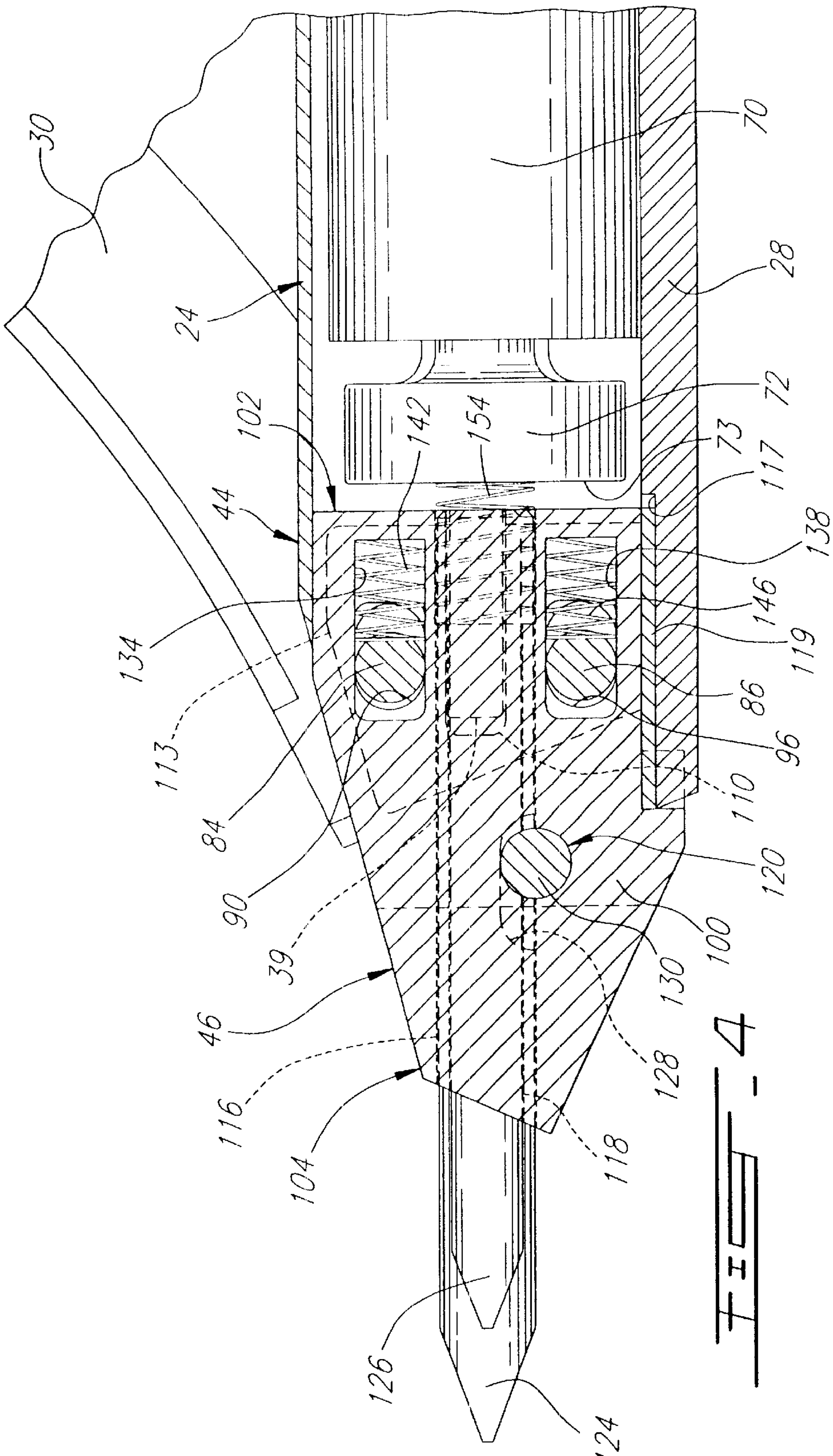

30
70
28
24
72
102
142
154
73
117
44
138
146
134
119
86
113
96
110
84
120
90
100
39
130
46
128
116
118
104
126
124

FIG. 4

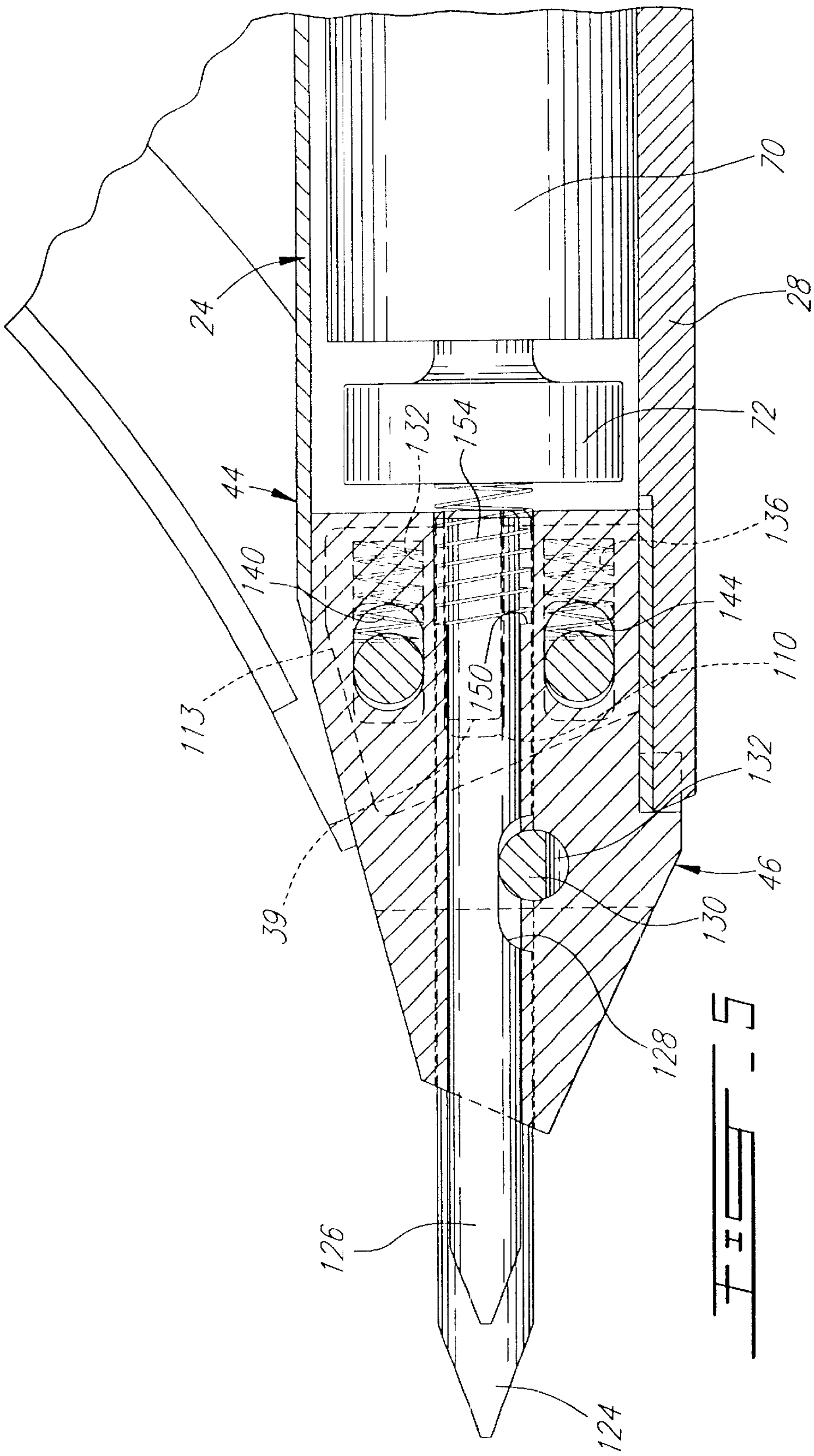

70
28
24
72
132
154
44
136
140
144
113
150
110
132
46
39
130
128
126
124

FIG. 5

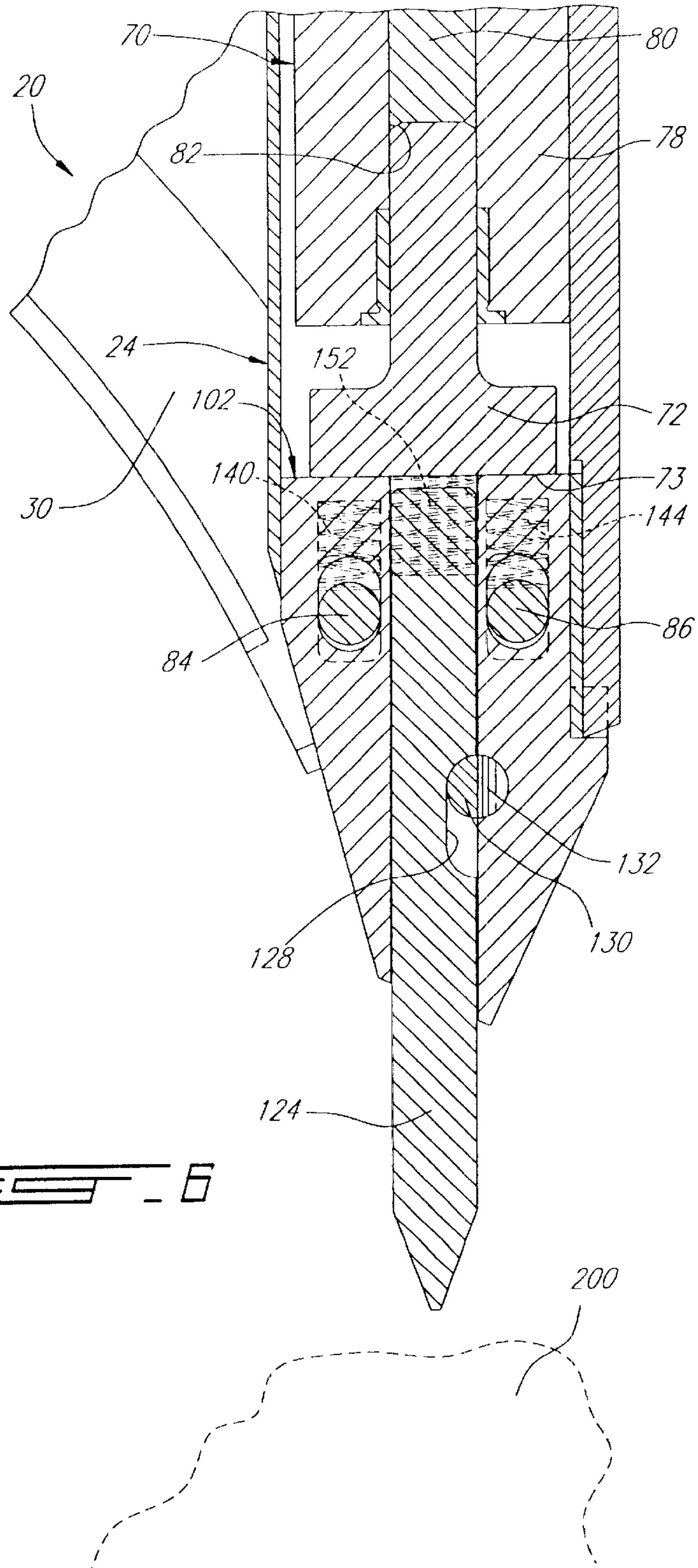


FIG. 6

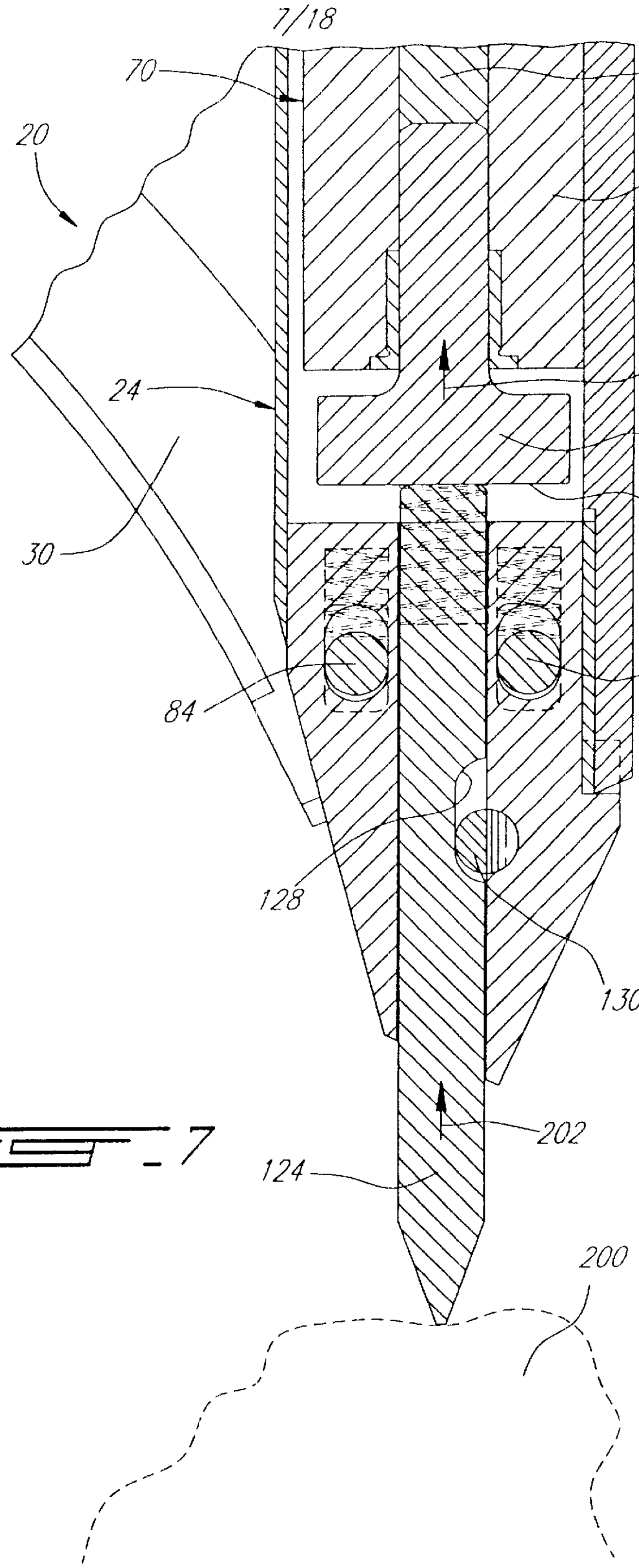


FIG. 7

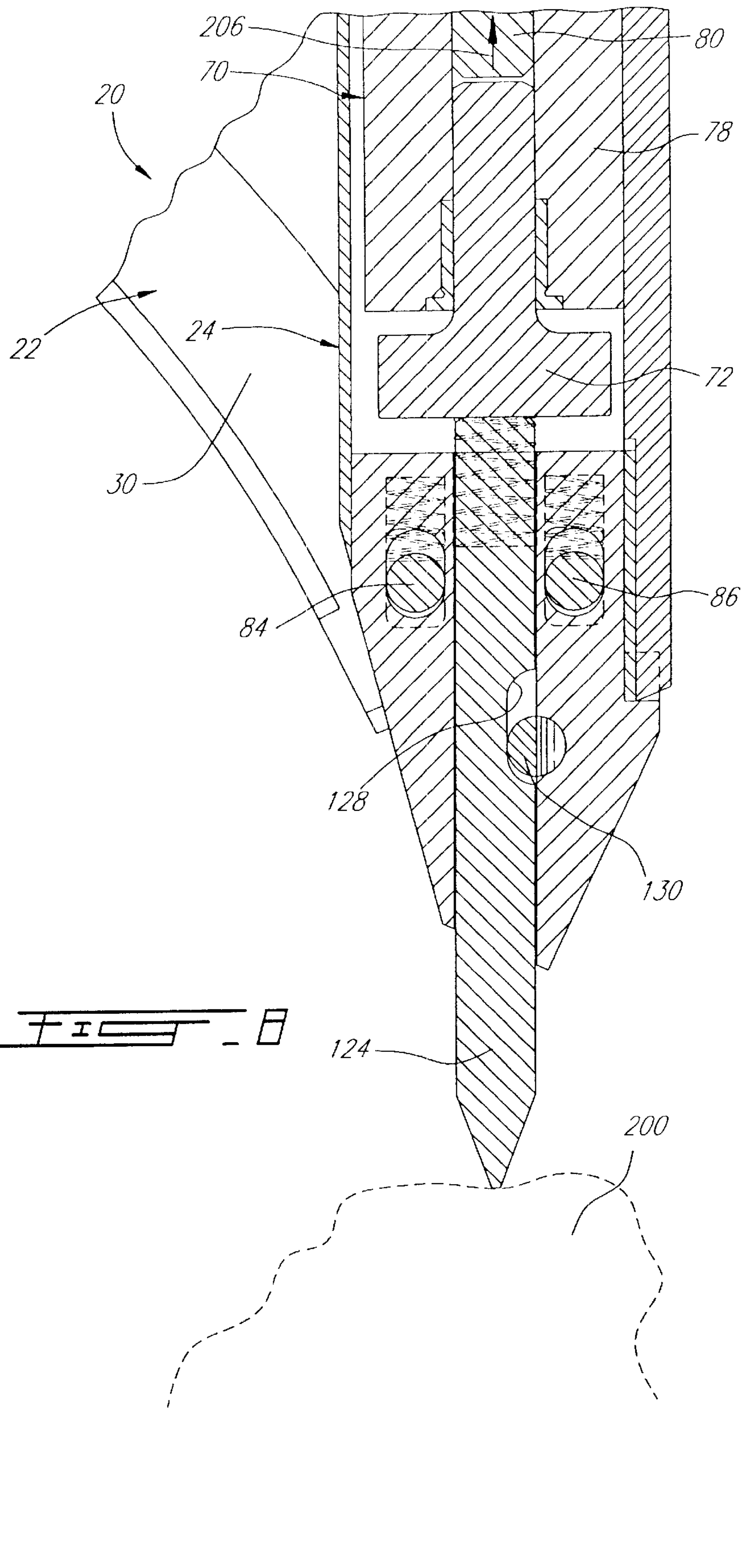


FIG. 8

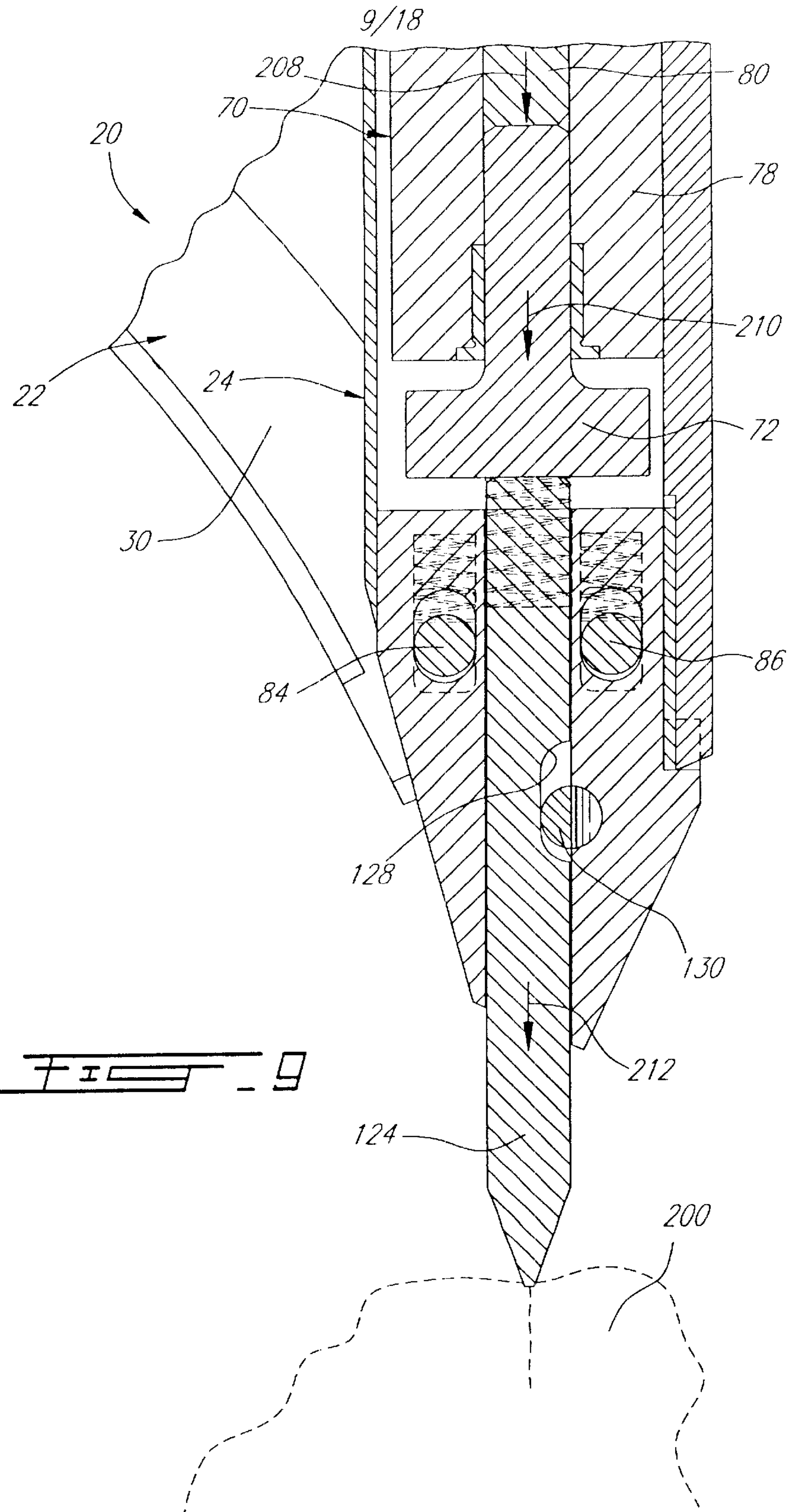


FIG. 9

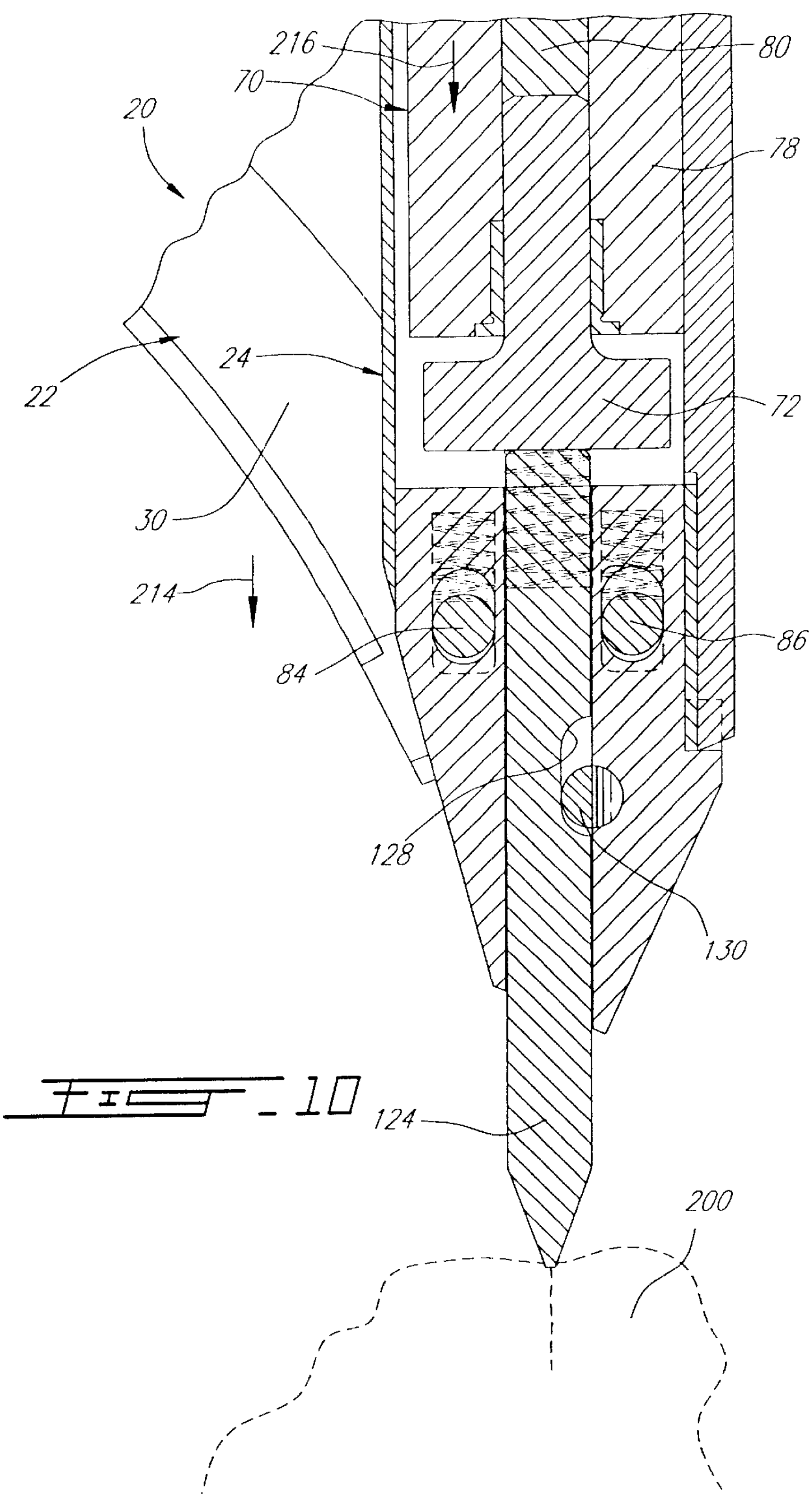


FIG. 10

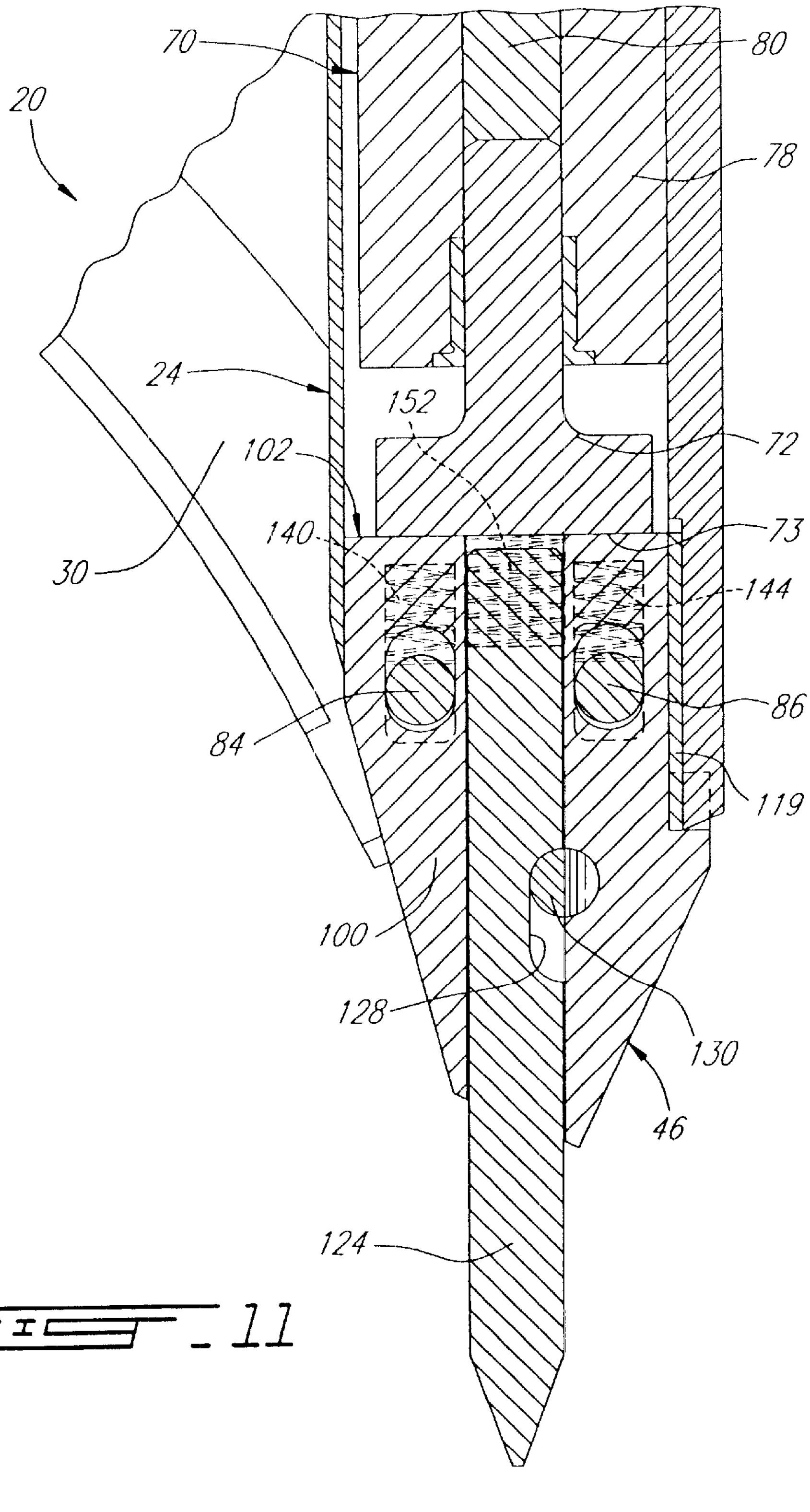
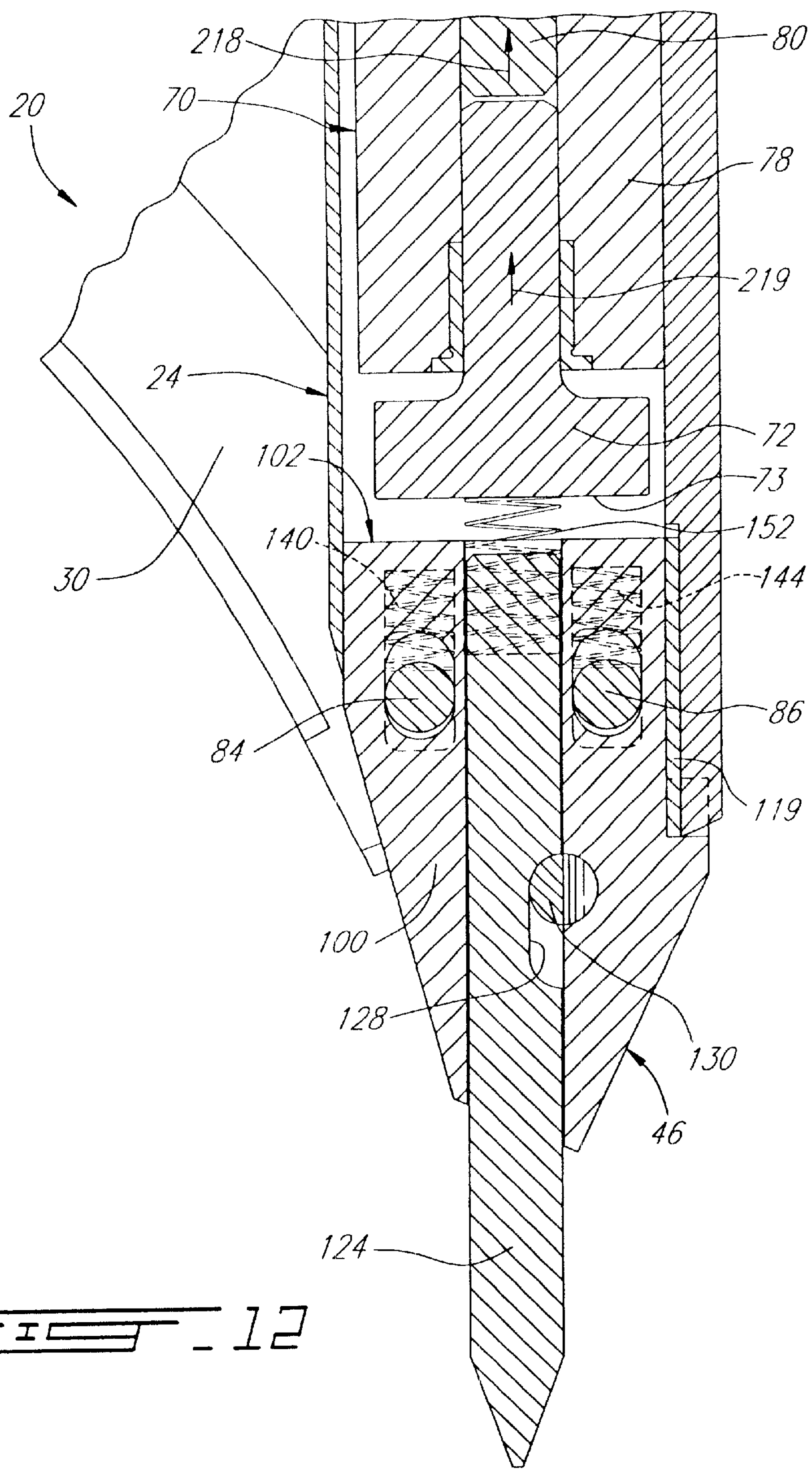


FIG. 11



218
80
20
70
78
219
24
72
102
73
152
140
144
30
84
86
119
100
128
130
46
124

FIG. 12

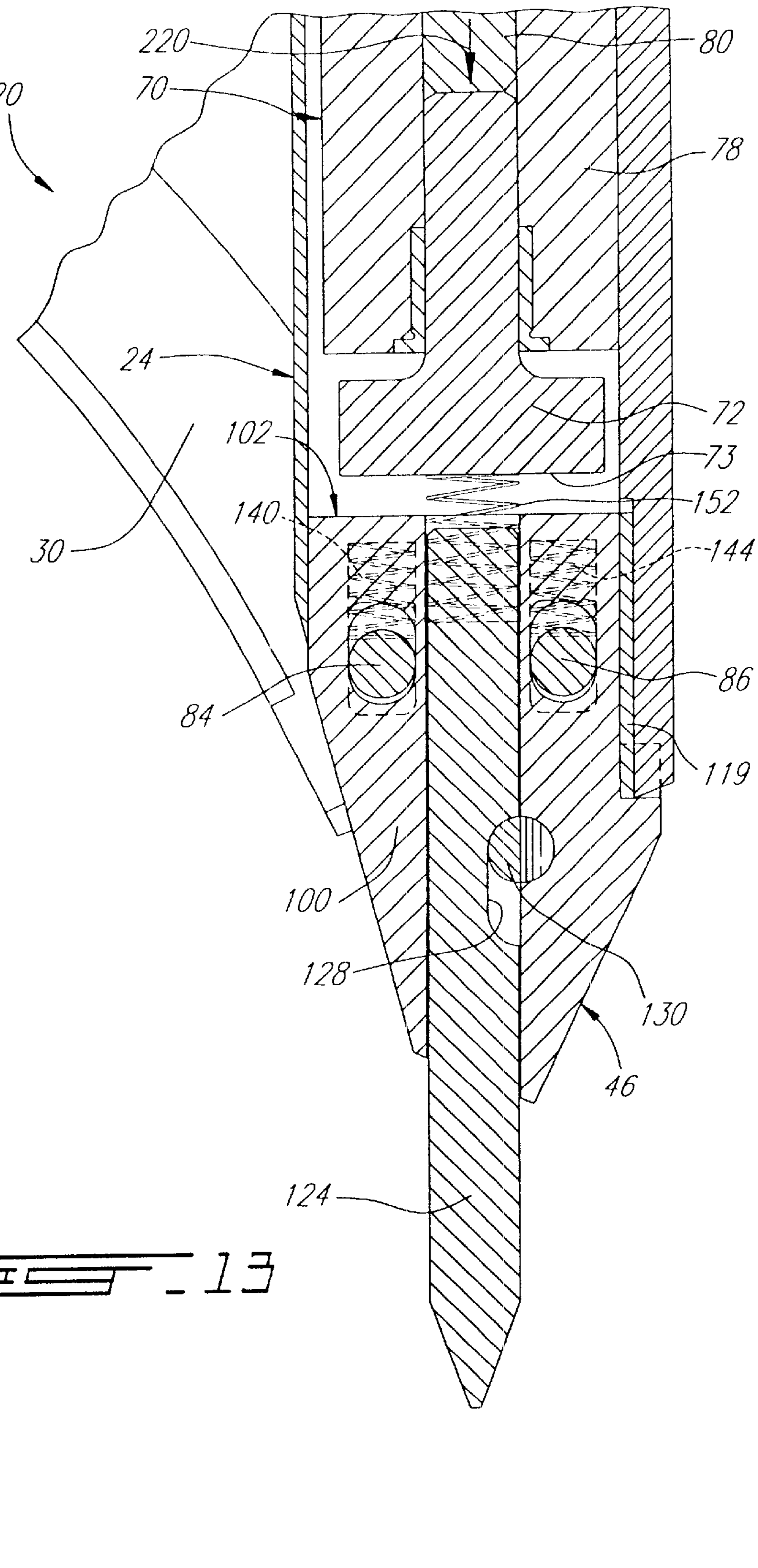
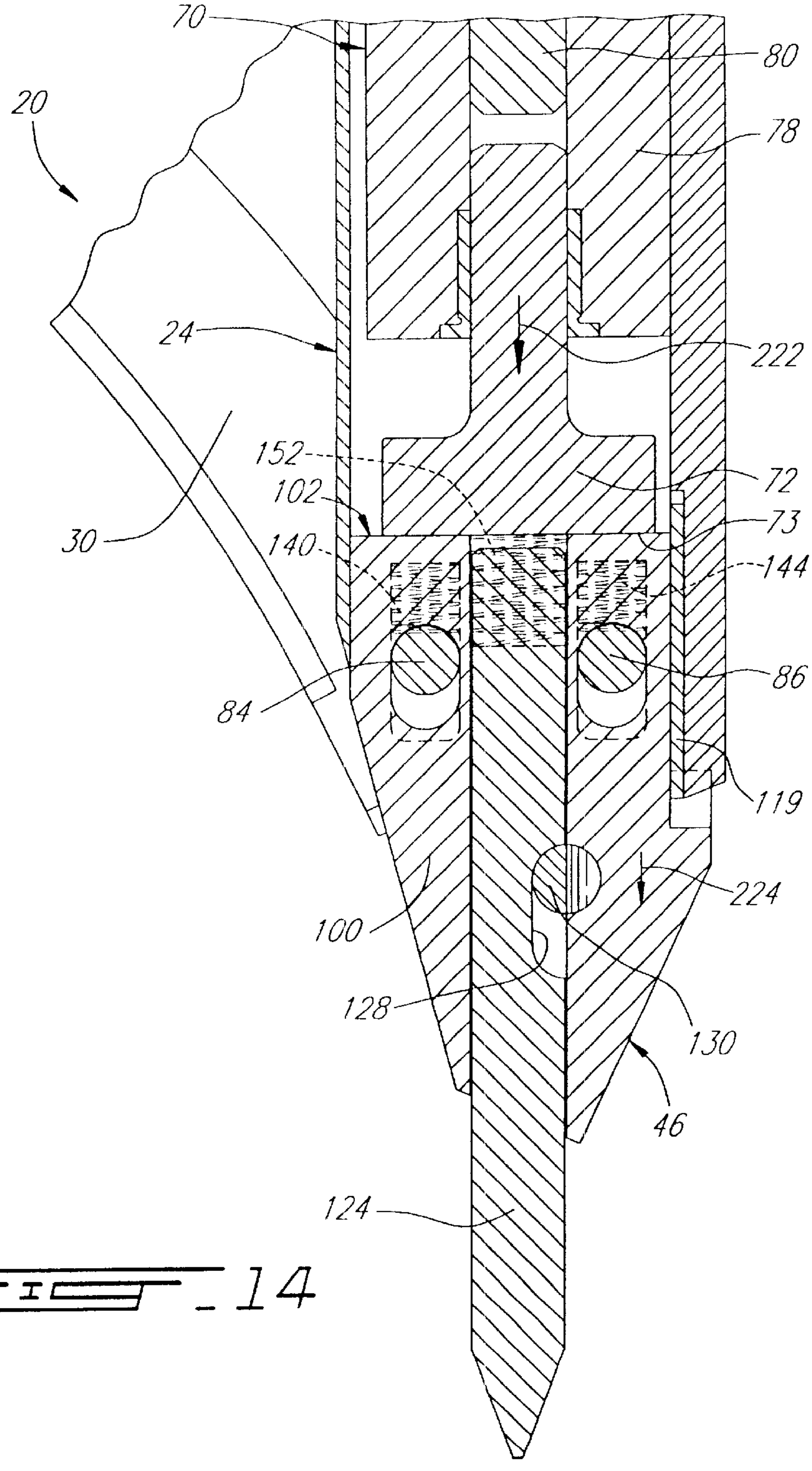

220
80
20
70
78
24
72
102
73
140
152
30
144
84
86
119
100
128
130
46
124

FIG. 13



70
80
78
20
24
222
152
72
102
73
140
144
30
86
84
119
224
100
128
130
46
124

FIG. 14

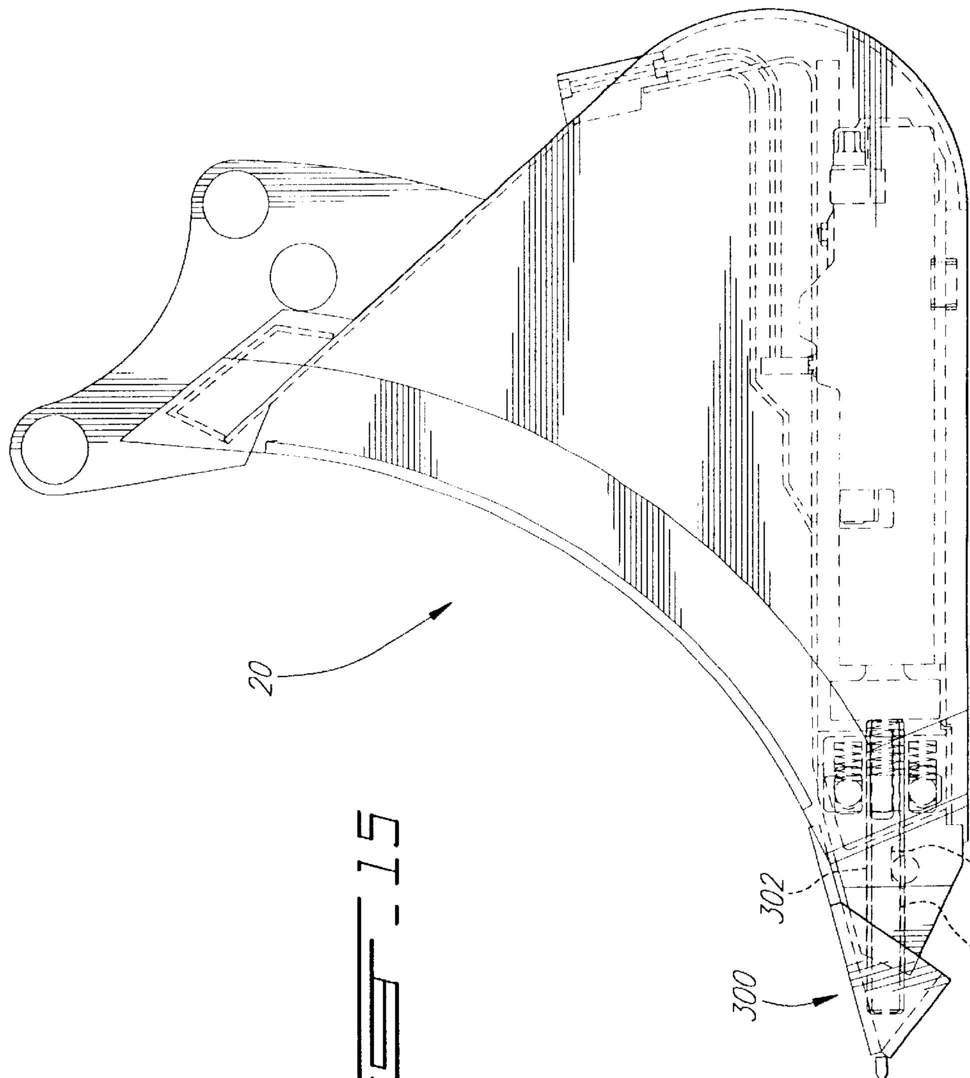


FIG-15

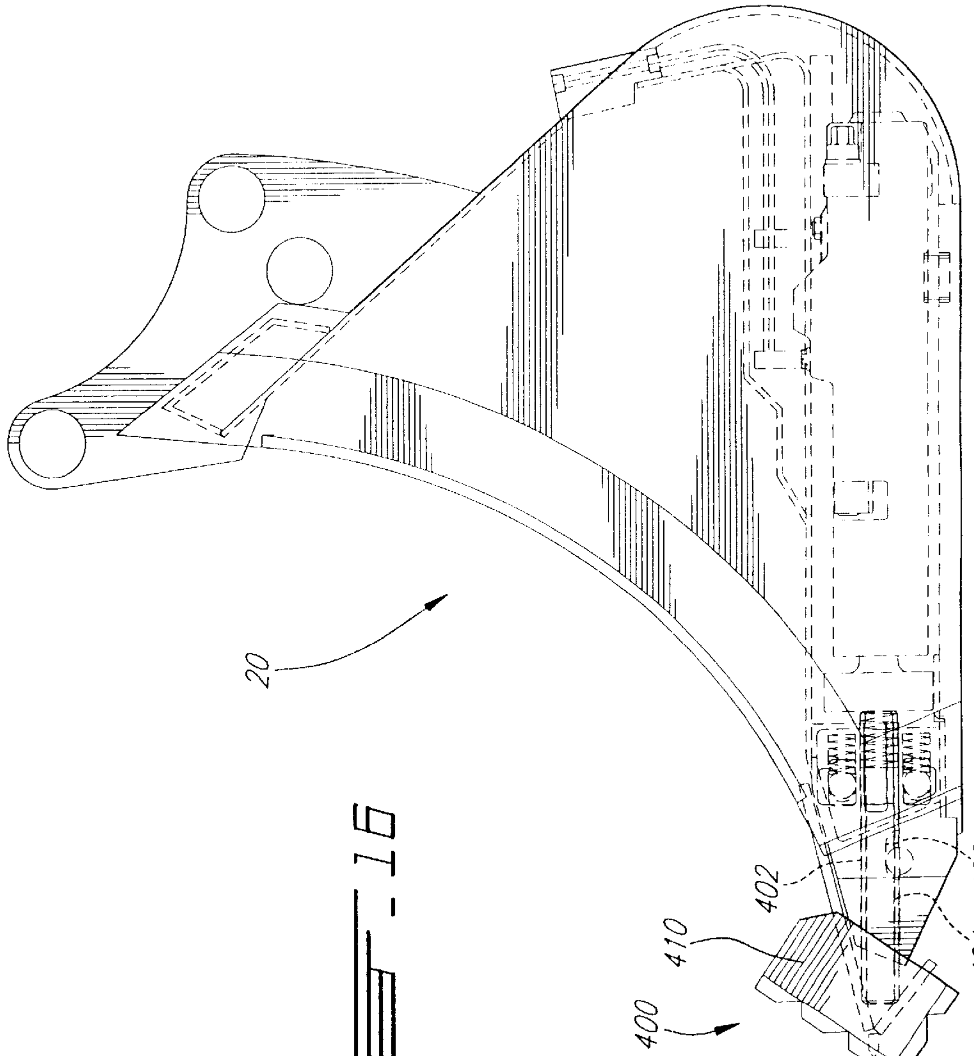


FIG-16

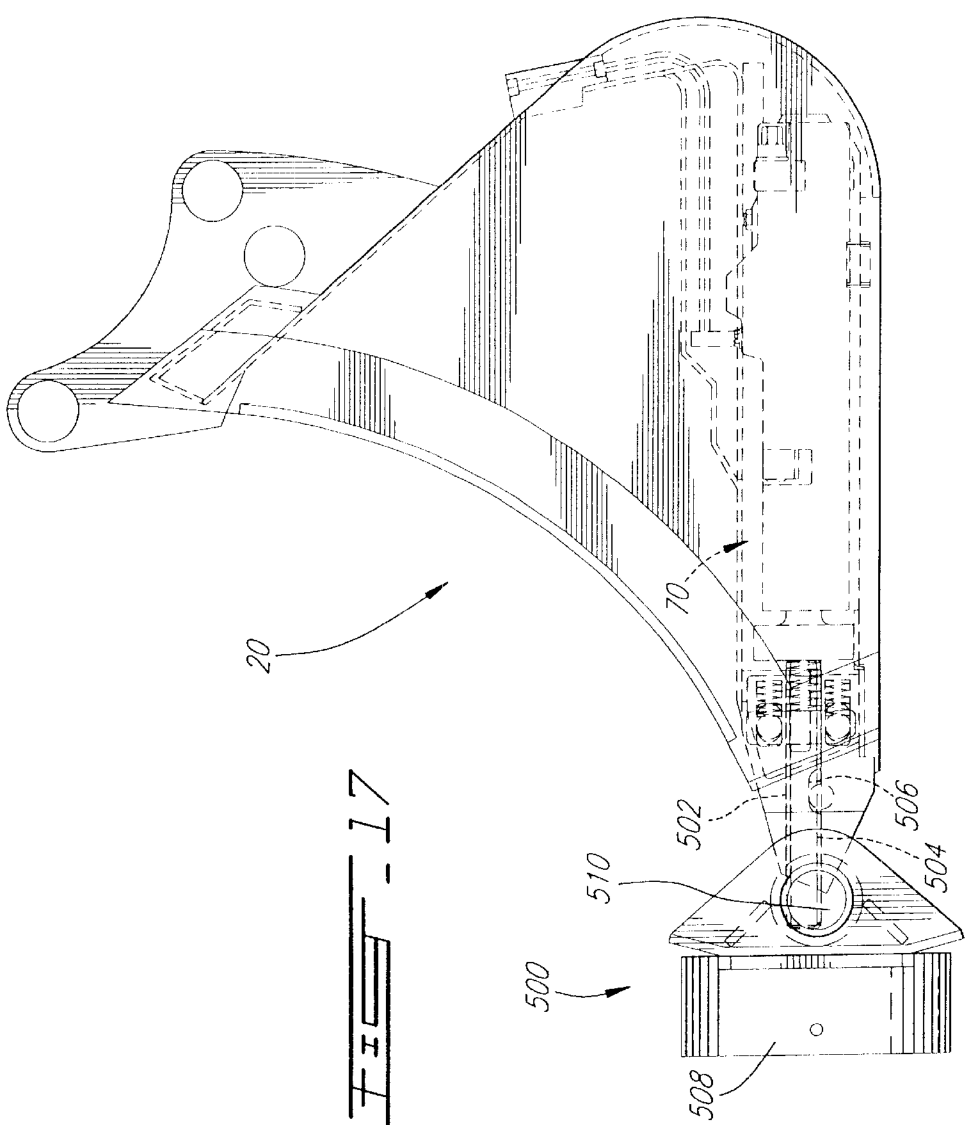


FIG - 17

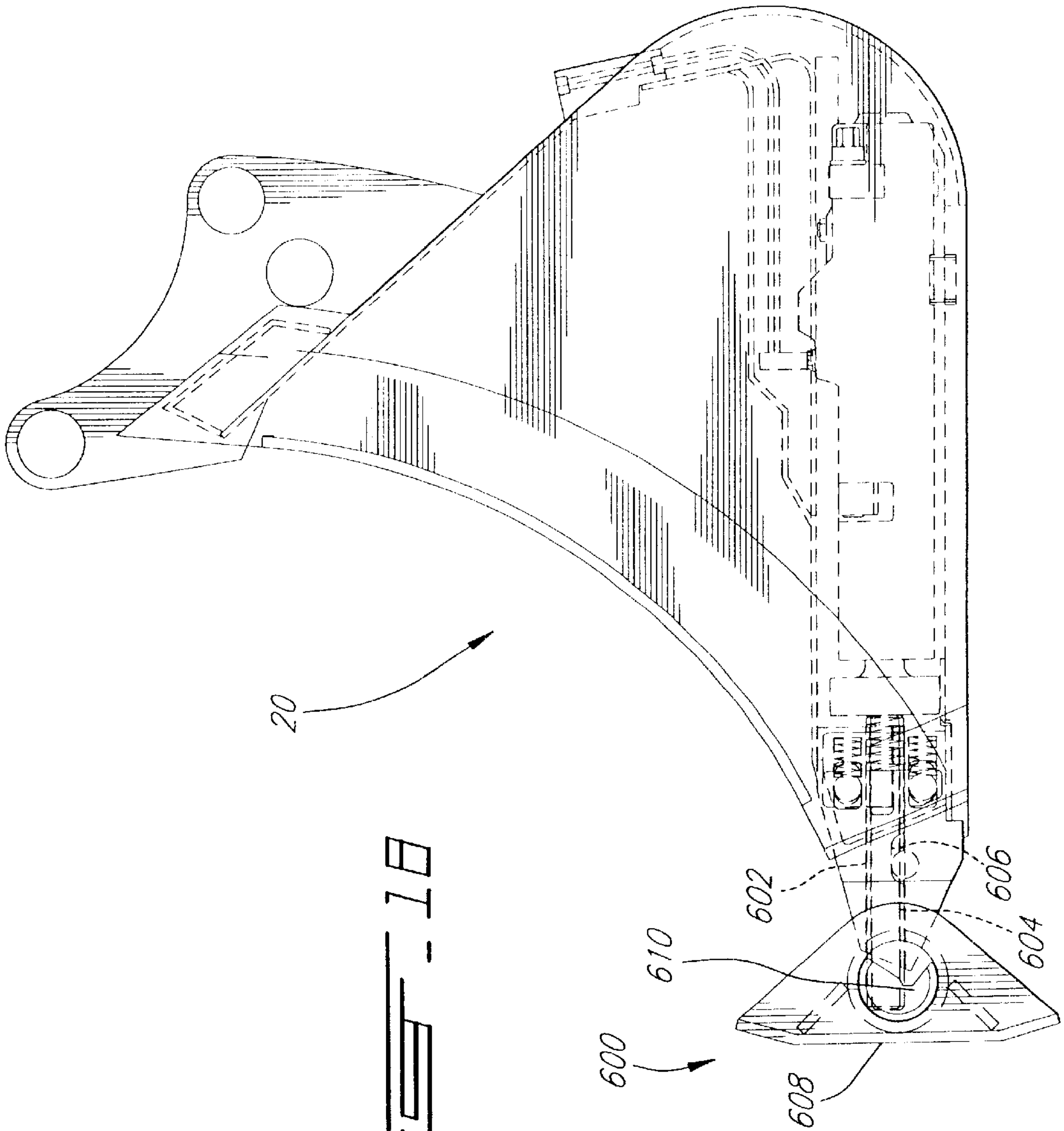


FIG. 18

EXCAVATION BUCKET INCORPORATING AN IMPACT ACTUATOR ASSEMBLY

FIELD OF THE INVENTION

The present invention relates to excavation buckets. More particularly, the present invention is concerned with excavation buckets incorporating an impact actuator assembly.

BACKGROUND OF THE INVENTION

The prior art is replete with configurations of excavating buckets designed to better dig into hard soils.

For example, U.S. Pat. No. 4,625,438 entitled: "Excavating bucket having power driven, individually controlled digging teeth" issued on Dec. 2, 1986 to Daniel S. Mozer describes an excavating bucket having a leading edge provided with a row of individually pneumatically driven digging teeth. Each digging tooth is connected to a pneumatic impact hammer that reciprocates the tooth at high speed and with great force.

The excavating bucket described by Mozer has several drawbacks. For example, since pneumatic impact hammers are used, the earth working machine to which the excavating bucket is mounted must be provided with an air compressor and adequate supplemental conduits between the air compressor and the bucket. Also, since each tooth is connected to an individual pneumatic impact hammer, the total weight of the excavating bucket is much higher than the weight of a conventional bucket, which is a disadvantage when the arm of the earthmoving machine is fully extended, since conventional earth moving machines are generally designed to move weights similar to the weight of conventional buckets. Yet another drawback of the excavating bucket of Mozer is that since impact hammers generally require an external force compressing the internal piston, the teeth will be displaced by the hammers only when they supply this compression force by contacting a hard soil.

Patent Cooperation Treaty application published under number WO 93/23210 on Nov. 25, 1993, entitled "IMPACT DEVICE" and naming Jack Benton Ottestad as inventor describes a custom impact device mounted to an excavating bucket. While the device described by Ottestad is an improvement over the device of Mozer, it still has the above mentioned drawback that the blade is only actuated by the impact device when the blade is in a position to compress the internal piston of the impact device.

OBJECTS OF THE INVENTION

An object of the present invention is therefore to provide an improved excavating bucket incorporating an impact actuator.

Another object of the invention is to provide an excavating bucket incorporating an impact actuator free of the above mentioned drawbacks of the prior art.

SUMMARY OF THE INVENTION

More specifically, in accordance with the present invention, there is provided an excavation bucket comprising:

- a bucket body including a base portion and lateral side portions; the base portion having a longitudinal axis;
- a movable floor so mounted to the bucket body as to (a) be longitudinally slidable between a retracted position and an extended position, and (b) provide a free space between the base portion and the movable floor; and

- means for selectively slide the movable floor between the retracted and extended positions; the sliding means being mounted in the free space.

According to another aspect of the present invention there is provided an excavation bucket comprising:

- a bucket body including a base portion and lateral side portions; the base portion having a longitudinal axis;
- a movable head so mounted to the bucket body as to be longitudinally slidable between a retracted position and an extended position; the movable head including a movable head body provided with a proximate end and a distal end and at least one tool receiving aperture extending from the proximate end to the distal end;
- a movable floor so mounted to the movable head body as to provide a free space between the base portion and the movable floor;
- an impact actuator including an impact actuator body mounted to the bucket body and impact head so mounted to the actuator body as to be selectively movable between a retracted position and an extended position; the impact actuator being mounted in the free space; and
- at least one tool configured and sized to be slidably inserted in the tool receiving aperture of the movable head body; when inserted in the tool receiving aperture, the tool being slidable between an extended position and a retracted position where the tool contacts the impact head; wherein the impact head, when in its extended position, (a) contacts the proximate end of the movable head body when the tool is in its extended position and (b) contacts the tool when the tool is in its retracted position.

Other objects, advantages and features of the present invention will become more apparent upon reading of the following non restrictive description of preferred embodiments thereof, given by way of example only with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the appended drawings:

FIG. **1** is a side elevational view illustrating an excavating bucket according to an embodiment of the present invention;

FIG. **2** is an enlarged top plan view of the excavating bucket of FIG. **1**;

FIG. **3** is an enlarged front elevational view of the excavating bucket of FIG. **1**;

FIG. **4** is a sectional side elevational view taken along line **4**—**4** of FIG. **2**;

FIG. **5** is a sectional side elevational view taken along line **5**—**5** of FIG. **2**;

FIG. **6** is a side sectional view illustrating the front portion of the excavating bucket of FIG. **1** before a contact with a rock;

FIG. **7** is a side sectional view illustrating the excavating bucket of FIG. **1** after a contact with a rock and before an impact of the impact actuator;

FIG. **8** is a side sectional view illustrating the excavating bucket of FIG. **1**, where the internal hammer is preparing an impact;

FIG. **9** is a side sectional view illustrating the excavating bucket of FIG. **1** during an impact of the impact actuator;

FIG. **10** is a side sectional view illustrating the excavating bucket of FIG. **1** after an impact;

FIG. **11** is a side sectional view illustrating the front portion of the excavating bucket of FIG. **1** before an impact of the impact actuator, where the digging teeth are not in contact with soil;

FIG. **12** is a side sectional view illustrating the excavating bucket of FIG. **1**, where the internal hammer is preparing an impact;

FIG. **13** is a side sectional view illustrating the excavating bucket of FIG. **1** during an impact of the internal hammer of the impact actuator;

FIG. **14** is a side sectional view illustrating the excavating bucket of FIG. **1** after an impact of the internal hammer of the impact actuator;

FIG. **15** is a side elevational view of the excavating bucket of FIG. **1** provided with a clay cutting attachment;

FIG. **16** is a side elevational view of the excavating bucket of FIG. **1** provided with a root shredding attachment;

FIG. **17** is a side elevational view of the excavating bucket of FIG. **1** provided with a picket ramming attachment; and

FIG. **18** is a side elevational view of the excavating bucket of FIG. **1** provided with a compaction attachment.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. **1** to **3** of the appended drawings, an excavation bucket **20** according to a preferred embodiment of the present invention will be described. The excavation bucket **20** generally includes a bucket body **22**, a longitudinally movable floor **24** and an impact actuator assembly **26**.

The bucket body **22** has a longitudinal axis **23** (FIG. **2**) and includes a base **28**, a pair of lateral side walls **30**, **32**, a rear wall **34**, and a pair of mounting elements **36**, **38** each provided with apertures **40** to which the end of the arm of a conventional earth moving machine (not shown) may be secured.

The lateral walls **30** and **32** are respectively provided with forward extension elements **31**, **33** made of a material, for example HARDOX 400™, that may be sharpened to a cutting edge. Two guiding elements **35**, **37** (see FIG. **2**) provided with respective projections (see numeral **39** in FIG. **4**) are respectively and fixedly mounted to the internal surfaces of the walls **30**, **32**. The purpose of the guiding elements **35**, **37** will be described hereinafter.

The movable floor **24** includes a proximate end **42** and a distal end **44**. The distal end **44** is mounted to a movable head **46** of the impact actuator assembly **26**. The movable floor **24** generally consists of a first flat portion **48**, a first angled portion **50**, a second flat portion **52**, a second angled portion **54**, third flat portion **56**, first and second vertical portions **58** and **60** (FIG. **3**), first and second lateral flat portions **62**, **64** (FIG. **3**) and a rear curved portion **66**. As will be described hereinbelow, the movable floor **24** is so mounted to the movable assembly **46** as to be reciprocately longitudinally slidable between a retracted position (illustrated in FIG. **1**) and an extended position (shown in FIG. **14**).

The configuration and position of the movable floor **24** with respect to the bucket body **22** create a free space **68** (FIG. **1**) between the generally inverted U-shaped portion of the movable floor **24** and the base **28** of the bucket body **22**.

It is to be noted that the configuration of the movable floor **24** is at least partially dictated by the required shape of the free space **68** as will be described hereinbelow.

The impact actuator assembly **26** includes an impact actuator **70**, an impact head **72** and a movable head **46**.

The impact actuator **70** is fixedly mounted to the bucket **22** in the free space **68** between the movable floor **24** and the base **28**. To hydraulically connect the impact actuator **70** to the earth moving machine (not shown) the impact actuator **70** also includes a manifold **74** to which the hydraulic fluid conduits (not shown) of the earth moving machine may removably be connected. Hydraulic fluid conduits **76** are fixedly connected between the manifold **74** and the impact actuator **70**. Grease conduits (not shown) are also provided between the manifold **74** and the impact actuator **70** to allow maintenance of the impact actuator **70** without requiring the removal of the movable floor **24**.

It is to be noted that since the impact actuator **70** is similar to conventional impact actuators that are conventionally mounted to the booms of earth moving machines, conventional fluid conduits of the earth moving machine may advantageously be connected to the manifold **74** for the selective operation of the impact actuator. Accordingly, the impact actuator assembly **70** is advantageously an hydraulic impact actuator. However, a pneumatic impact actuator (not shown) could also be used, provided that adequate air supply is present on the earth moving machine. Of course, other modifications would possibly be required to allow a pneumatic impact actuator to be used.

The different elements and the general operation of a hydraulic impact actuator, such as impact actuator **70**, are believed well known in the art. Accordingly, for concision purposes, only elements relevant to the description or to the operation of the excavation bucket incorporating an impact actuator assembly of the present invention will be described hereinbelow. It will therefore be understood that omissions or generalizations in the description or in the operation of the impact actuator **70** should not be construed in any way as limiting the present invention.

Referring briefly to FIG. **6** of the appended drawings showing a sectional view of the impact actuator **70**, the impact actuator **70** includes a generally tubular body **78** and a reciprocating hammer **80** slidably mounted in an axial aperture **82** of the body **78** for longitudinal movements between first and second positions.

The impact head **72** has a generally T-shape crosssection and includes an impact surface **73**, as can be better seen in FIG. **6**. The configuration and size of the impact head **72** allow the impact head **72** to be slidably mounted in the axial aperture **82** of the body **78**.

Returning to FIGS. **1** to **3**, the movable head **46** is mounted to the lateral walls **30**, **32** of the bucket body **22** for reciprocal sliding movements between retracted and extended positions via a pair of cylindrical mounting pins **84**, **86**. More specifically, the cylindrical pin **84** extends through a circular aperture **88** of the wall **30**, a transversal oblong aperture **90** (see FIG. **4**) of the movable head **46** and a circular aperture **92** of the wall **32**. Similarly, the cylindrical pin **86** extends through a circular aperture **94** of the wall **30**, a transversal oblong aperture **96** (see FIG. **4**) of the movable head **46** and a circular aperture **98** of the wall **32**.

It is to be noted that the movable head **46** and the attached movable floor **24** may easily be removed from the bucket body **22** by removing the mounting pins **84**, **86** and by longitudinally sliding the movable head **46** from the bucket **22**.

The movable head **46** includes a solid body **100** having a proximate portion **102**, a distal portion **104** and opposite lateral walls **106**, **108**.

Turning now more specifically to FIGS. **3**, **4** and **5** of the appended drawings the various elements of the movable head **46** will be described.

The lateral walls **106, 108** are provided with respective channels **110, 112** configured and sized to slidably receive the projections **39** of the guiding elements **35, 37** to thereby slidably mount the movable head **46** to the bucket **22**. It is to be noted that the oblong shape of the apertures **90, 96** of the body **100** allow longitudinal sliding movements of the movable head **46** with respect to the bucket **22** while adequately securing the head **46** to the bucket **22**. It is also to be noted that the cooperation of the projections **39** with the channels **110, 112** allow longitudinal movements of the movable head **46** while preventing other movements of the movable head.

The lateral walls **106, 108** are also provided with respective friction reducing elements **113, 115**, partially embedded in cavities (not shown) of the lateral walls **106, 108**, and in contact with the guiding elements **35, 37** to reduce the wear of the surface of both the guiding elements and the body **100**. Similarly, the base **28** of the bucket **22** is provided with a shoulder **117** receiving a friction reducing pad **119** onto which the bottom of the body **100** rests. Again, the purpose of the friction reducing pad **119** is to extend the useful life of both the base **28** and the body **100**. While the material forming the friction reducing elements **113, 115** and **119** may be modified, it has been found that Nyloil™ type material has been found an adequate friction reducing material for the intended purpose.

The body **100** includes three longitudinal tool receiving apertures **114, 116** and **118** and a tool locking mechanism **120**. In FIGS. **1–14**, generally cylindrical teeth **122, 124** and **126** are inserted in respective apertures **114, 116** and **118**. Each tooth **122–126** is provided with a semi-oblong tangential channel **128** in which a rotatable rod **130** of the locking mechanism **120** is inserted. The rod **130** includes tangential cutouts **132** (FIG. **5**) registered with the tool receiving apertures **114, 116** and **118**. The rod **130** may be rotated between a locking position (illustrated in the figures) where the rod **130** enters the channels **128** and a non locking position (not shown) where the cutouts **132** face the channels **128** of the teeth **122, 124** and **126** to thereby allow the teeth to be removed from the respective longitudinal tool receiving apertures **114, 116** and **118**. As an anti-theft feature, the tool locking mechanism **120** may also includes means (not shown) for preventing unauthorized rotation of the rod **130**.

The body **100** also includes four longitudinal spring receiving apertures **132, 134, 136** and **138**. The apertures **132** and **134** are open to the oblong aperture **90** while the apertures **136, 138** are open to the oblong aperture **96**. The apertures **132–138** are configured and sized to receive respective compression springs **140, 142, 144** and **146** used to bias the movable head **46** towards its retracted position shown in FIGS. **1–5**. The compression springs **140–146** are therefore provided between the bottom of their respective aperture **132–138** and one of the cylindrical mounting pin **84, 86**. As will be understood by one of ordinary skill in the art, the generally cylindrical mounting pins **84, 86** are advantageously provided with flat portions (not shown) onto which the springs **140–146** may rest.

The longitudinal apertures **114** and **118** of the body **100** are provided with respective spring receiving shoulders **148, 150**. A first compression spring **152** (see FIG. **3**) is mounted coaxially with the cylindrical tooth **122** between the shoulder **148** and the impact surface **73** of the impact head **72**. Similarly, a second compression spring **154** (see FIGS. **4** and **5**) is mounted coaxially with the cylindrical tooth **126** between the shoulder **150** and the impact surface **73** of the impact head **72**.

As will be easily understood by one of ordinary skill in the art, the purpose of the compression springs **152, 154** is to maintain an adequate longitudinal pressure onto the impact head **72** to ensure that the impact head **72** is not freely movable. The compression springs **152, 154** therefore have a sufficient capacity to apply an adequate pressure onto the impact head **72**.

Operation of the excavating bucket **20** will now be described with reference to FIGS. **6–14**. As will be apparent to one skilled in the art upon reading of the following description, two modes of operation exist. In a first mode of operation, illustrated in FIGS. **6–10** and referred to as the rock-breaking mode, the excavating bucket **20** is used to break rocks or other hard soil and then to scoop it up in a conventional manner. In a second mode of operation, illustrated in FIGS. **11–14** and referred to as the soil dumping mode, the movable floor **24** is used to disengage soil packed in the bucket body **22**.

It is to be noted that FIGS. **6–14** are sectional views taken along the longitudinal axis **23** of the bucket **22** (see FIG. **2**).

Turning now to FIGS. **6–10** of the appended drawings, the first mode of operation of the excavating bucket **20** of the present invention will be described. Each of these figures illustrates a general step in the breakage of a rock **200**.

FIG. **6** of the appended drawings illustrates the excavating bucket **20** in its initial position before the tooth, **124** contacts the rock **200**. Gravity maintains the tooth **124** in a fully extended position where the rod **130** contacts the upper end of the semi-oblong channel **128**. The springs **152, 154** (only one shown) are partially compressed by the weight of the impact head **72** and by the downward pressure exerted by the hammer **80** of the impact actuator **70** when it is in its rest state. The impact surface **73** of the impact head **72** therefore rests against the proximate portion **102** of the body **100**. The springs **140, 142, 144** and **146** (only two shown) are partially compressed to maintain the movable head **46** in its retracted position by maintaining an adequate pressure between the cylindrical mounting pins **84, 86** and the body **100**.

Turning now to FIG. **7**, the contact between the distal end of the tooth **124** and the rock **200** is illustrated. The tooth **124** is pushed in the direction of arrow **202** to reach its fully retracted position illustrated in this figure. In this position, the proximate end of the tooth **124** abuts the impact surface **73** of the impact head **72**. This upward movement of the tooth **124** is caused by the movement of the arm (not shown) of the earth moving machine that pushes the excavation bucket **20** downwardly while the rock **200** prevent further forward movements of the tooth **124**. This upward movement of the tooth **124** causes the impact head **72** to be pushed upward (see arrow **204**) towards its fully retracted position while still contacting the hammer **80**.

FIG. **8** of the appended drawings illustrates the impact actuator **70** preparing for an impact. The hammer **80** is moved away from the impact head **72** (see arrow **206**) by the energization of the impact actuator **70** by the operator. It is to be noted that since the impact head **72** is in its fully retracted position, it does not follow the hammer **80**.

FIG. **9** illustrates an impact of the impact actuator **70**. During this impact, the hammer **80** is forcefully moved downwardly (see arrow **208**) in the longitudinal actuator body **78**. The hammer **80** therefore forcefully strikes the impact head **72** that, in turn, forcefully pushes (see arrow **210**) against the proximate end of the tooth **124**. Since the impact actuator **70** is fixedly mounted to the bucket body **22**, the impact of the hammer **80** onto the impact head **72** will cause the tooth **124** to forcefully move downward (see arrow **212**) in an attempt to break the rock **200**.

Finally, FIG. **10** of the appended drawings illustrates the downward movement (see arrow **214**) of the bucket body **22** caused by the downward motion of the arm (not shown) of the earth moving machine. Since the body **78** of the impact actuator **70** is fixedly mounted to the bucket **22**, this downward movement of the bucket **22** will cause the body **78** to move downward (see arrow **216**). The tooth **124**, the impact head **72** and the hammer **80** will therefore be repositioned in a position similar to the position illustrated in FIG. **7**, ready for another impact.

Of course, depending on the hardness of the rock **200**, it may take many impacts of the hammer **80** onto the impact head **72** before the rock **200** is fractured as shown in FIG. **10**. However, conventional impact actuator assemblies usually have a frequency of impacts of about 15 impacts every second.

It is to be noted that since the distal end of the tooth **124** is in constant contact with the rock **200** the proximate end of the tooth **124** is in constant contact with the impact head **72**. The impact surface **73** of the impact head **72** thus always impacts onto the proximate end of the tooth **124** (and possibly teeth **122** and **126** if they contact the rock **200**) without impacting onto the body **100**, which increases the useful life of the body **100**.

It is also to be noted that, as will be easily understood by one skilled in the art, the movements of the hammer **80** into the actuator body **78** are not independently controlled by the operator of the earth moving machine. Indeed, the impact actuator **70**, when energized, takes control of the movements of the hammer **80**. Therefore, the operator simply has to decide when the impact actuator **70** should be used to more easily scoop or break the intended material.

Turning now to FIG. **11–14** of the appended drawings, the second mode of operation of the excavation bucket **20**, i.e. in view of disengaging soil (not shown) that has been packed in the bucket body **22**, will be described.

The main difference between the second mode of operation of the excavation bucket **20** and its first mode of operation described hereinabove is that, in the second mode, the teeth **122–126** are not in contact with a hard surface and thus not in contact with the impact head **72**. The downward movement of the impact head **72** will therefore cause it to contact forcefully the body **100** of the impact head **46**. This impact will move the movable floor **24** forward and therefore assist in the disengagement of packed soil in the bucket **22**.

More specifically, FIG. **11** illustrates the excavation bucket **20** in a non operating state. The tooth **124** is maintained in its fully extended position by gravity. The springs **152, 154** (only one shown) are partially compressed by the weight of the impact head **72** and by the downward pressure exerted by the hammer **80** of the impact actuator **70** when it is in its rest state. The impact surface **73** of the impact head **72** therefore rests against the proximate portion **102** of the body **100**. The springs **140, 142, 144** and **146** (only two shown) are partially compressed to maintain the movable head **46** in its retracted position by maintaining an adequate pressure between the cylindrical mounting pins **84, 86** and the body **100**.

FIG. **12** illustrates the impact actuator **70** preparing an impact. The hammer **80** is moved upwardly (see arrow **218**) by the energization of the impact actuator **70** by the operator. It is to be noted that the impact head **72** is moved (see arrow **219**) from its extended position of FIG. **11** to its fully retracted position of FIG. **12** by the springs **152, 154**. Indeed, the energization of the impact actuator **70** removes the pressure from the hammer **80** onto the impact head **72** and therefore allows the springs **152, 154** to move the impact head **72** upwardly.

FIG. **13** illustrates the impact between the hammer **80** and the impact head **72**. The hammer **80** is forcefully moved downwardly (see arrow **220**) and impacts the impact head **72**.

The downward movement (see arrow **222**) of the impact head **72** is illustrated in FIG. **14**. The impact surface **73** of the impact head **72** compresses the springs **152, 154** to contact the proximate portion **102** of the body **100** to forcefully slide it downwardly (see arrow **224**). Of course, since the movable floor **24** is fixedly mounted to the body **100**, it will also be downwardly slid. The movement of the body **100** also compresses the springs **140, 142,144** and **146**.

Turning briefly to FIG. **1** of the appended drawings, it is to be noted that the rear curved portion **66** of the movable floor **24** pushes the soil (not shown) packed in the bucket **22** when the movable floor **24** is slid as described hereinabove. This curved portion **66** also prevents large pieces of soil to enter the free space **68** between the movable floor **24** and the base **28**.

Returning to FIG. **14**, once the energy of the impact head **72** is transferred to the body **100**, the compressed springs **140–146** will move the body **100**, and thus the movable floor **24**, from its extended position illustrated in FIG. **14** to its retracted position illustrated in FIG. **11** while the compressed springs **152, 154** will move the impact head **72** from its extended position illustrated in FIG. **14** to its retracted position illustrated in FIG. **11** in preparation for further impacts.

As described hereinabove, since conventional impact actuators have a frequency of operation of about **15** cycles per second, the movable floor **24** will be slid back and forth about **15** times per second, thus facilitating the disengagement of soil packed in the bucket body **22**.

As will be easily understood by one skilled in the art, the excavation bucket **20** of the present invention has many advantages over the prior art, for example:

- the constant pressure applied by the springs **152, 154** onto the impact head **72** allow the impact actuator **70** to be used to disengage soil packed in the bucket body **22**;
- the fact that the impact head **72** does not contact the body **100** during hard soil breaking operations increases the useful life of the movable head **46**;
- the use of cylindrical mounting pins **84, 86** to mount the movable head **46** to the bucket **22** allows the moveable head **46** to be easily removed;
- the mechanical elements are mainly provided in the body **100** of the movable head **46**; and
- the body **100** is advantageously made of a single piece of an adequate metallic material.

FIG. **15** of the appended drawings illustrates the excavation bucket **20** to which a clay cutting attachment **300** has been fitted. The clay cutting attachment **300** includes a central mounting rods **302** and two lateral mounting rods **304** (only one shown) configured, sized and positioned to enter the three tool receiving apertures **114, 116** and **118** of the body **100**. Each mounting rod is provided with a tangential channel **306** enabling the rods to be locked in position by the tool locking mechanism **120** as described hereinabove with respect to the teeth **122, 124** and **126**. The edge **308** of the clay cutting attachment **300** is sufficiently sharp to easily cut through clay.

Turning now to FIG. **16**, a root shredding attachment **400** will be described. The root shredding attachment **400** includes a central mounting rods **402** and two lateral mounting rods **404** (only one shown) configured, sized and positioned to enter the three tool receiving apertures **114, 116** and **118** of the body **100**. Again, each mounting rod is provided with a tangential channel **406** enabling the rods to be locked in position by the tool locking mechanism **120**. The root shredding attachment **400** includes a serrated central blade **408** and a pair of lateral serrated blades **410** (only one shown).

FIG. **17** illustrates a picket ramming attachment **500** including a central mounting rods **502** and two lateral mounting rods **504** (only one shown) configured, sized and positioned to enter the three tool receiving apertures **114, 116** and **118** of the body **100**. Again, each mounting rod is provided with a tangential channel **506** enabling the rods to be locked in position by the tool locking mechanism **120**. The picket ramming attachment **500** includes a cylindrical picket holder **508** that may be pivoted about a pivot attachment **510**. A picket to be rammed (not shown) is inserted in the picket holder **508** and the impact actuator **70** is energized to help ramming the picket in the ground.

Finally, FIG. **18** illustrates a compaction attachment **600** including a central mounting rods **602** and two lateral mounting rods **604** (only one shown) configured, sized and positioned to enter the three tool receiving apertures **114, 116** and **118** of the body **100**. Again, each mounting rod is provided with a tangential channel **606** enabling the rods to be locked in position by the tool locking mechanism **120**. The compaction attachment **600** includes a flat compaction head **608** that may be pivoted about a pivot attachment **610**.

It is to be noted that the energization of the impact actuator **70** could be done automatically when the tooth **124** contacts a hard surface. For example, a pressure sensor (not shown) could be associated with the tooth **124** to detect the contact between the tooth **124** and the impact head **72**. The output of this sensor would be used to selectively energize the impact actuator **70** when the pressure detected is above a predetermined level. Another way of achieving the same result would be to provide a displacement sensor (not shown) detecting the displacement of the tooth **124** with respect to the bucket body **22**. Again, the output of this sensor would be used to selectively energize the impact actuator **70** when the displacement detected is above a predetermined level.

Although the present invention has been described hereinabove by way of preferred embodiments thereof, it can be modified, without departing from the spirit and nature of the subject invention as defined in the appended claims.

What is claimed is:

1. An excavation bucket comprising:

a bucket body including a floor portion and lateral side portions; said floor portion having a longitudinal axis;

a movable floor so mounted to said bucket body as to (a) be longitudinally slidable between a retracted position and an extended position, and (b) provide a free space between said floor portion and said movable floor; and

sliding means for selectively sliding said movable floor between said retracted and extended positions; said sliding means being mounted in said free space, said sliding means including an impact actuator.

2. An excavation bucket as recited in claim **1**, wherein said sliding means are fixedly mounted to said bucket body and associated with said movable floor.

3. An excavation bucket as recited in claim **1** wherein said impact actuator includes an actuator body mounted to said bucket body and an impact head so mounted to said actuator body as to be selectively movable between a retracted position and an extended position.

4. An excavation bucket as recited in claim **3**, further comprising a movable head so mounted to said bucket body as to be longitudinally slidable between a retracted position and an extended position; said movable floor being fixedly mounted to said movable head; said movable head including a movable head body and first biasing means biasing said movable head body towards said retracted position.

5. An excavation bucket as recited in claim **4**, wherein said first biasing means include at least one compression spring.

6. An excavation bucket as recited in claim **4**, further comprising second biasing means mounted between said movable head body and said impact head to bias said impact head towards its retracted position.

7. An excavation bucket as recited in claim **6**, wherein said second biasing means include at least one compression spring.

8. An excavation bucket as recited in claim **6**, wherein said movable head body includes at least one longitudinal tool receiving aperture.

9. An excavation bucket as recited in claim **8**, further comprising a clay cutting attachment releasably inserted in said at least one tool receiving aperture.

10. An excavation bucket as recited in claim **8**, further comprising a root shredding attachment releasably inserted in said at least one tool receiving aperture.

11. An excavation bucket as recited in claim **8**, further comprising a picket ramming attachment releasably inserted in said at least one tool receiving aperture.

12. An excavation bucket as recited in claim **8**, further comprising a compaction attachment releasably inserted in said at least one tool receiving aperture.

13. An excavation bucket as recited in claim **8**, wherein said movable head body has a proximate end and a distal end; said at least one longitudinal tool receiving aperture extending from said proximate end to said distal end; said movable head further including at least one tool configured and sized to be slidably inserted in said at least one tool receiving aperture; said at least one tool being slidable between an extended position and a retracted position where said at least one tool contacts said impact head; wherein (a) reciprocate movements of said impact head of said impact actuator slide said movable floor when said at least one tool is in its extended position and (b) reciprocate movements of said impact head of said impact actuator slide said at least one tool when said at least one tool is in its retracted position.

14. An excavation bucket as recited in claim **13**, wherein said movable head body also includes a tool locking mechanism to selectively lock said at least one tool in said at least one tool receiving aperture while allowing the sliding movements of said at least one tool between said extended and retracted positions.

15. An excavation bucket as recited in claim **14**, wherein said tool locking mechanism includes a cylindrical rod so mounted to a transversal aperture of said movable head body as to be rotatable between a locking position and an unlocking position; said cylindrical rod including at least one longitudinal channel facing a tangential channel of said at least one tool when said pivot bar in said non locking position.

16. An excavation bucket as recited in claim **13**, wherein said tool holding assembly includes three tool receiving longitudinal apertures.

17. An excavation bucket as recited in claim **16**, further comprising three teeth releasably mounted to a respective tool receiving aperture.

18. An excavation bucket as recited in claim **4**, wherein said movable head includes means for preventing its extended position to be exceeded.

19. An excavation bucket as recited in claim **18**, wherein said preventing means including means for mounting said movable head body to said bucket body while allowing said movable head body to slide between said retracted and extended positions.

20. An excavation bucket as recited in claim **19**, wherein said mounting means include a mounting rod, transversal oblong apertures of the movable head body and circular apertures of the lateral side portions; said mounting rod being configured and sized to be inserted in the oblong and circular apertures to therefore mount the movable head body to the side portions of the bucket body while allowing longitudinal movements of the movable head body.

21. An excavation bucket as recited in claim **1**, wherein said lateral side portions of said bucket body include internal lateral guides allowing longitudinal movements of said movable floor and preventing other movements of said movable floor.

22. An excavation bucket comprising:

a bucket body including a floor portion and lateral side portions; said floor portion having a longitudinal axis;

a movable head so mounted to said bucket body as to be longitudinally slidable between a retracted position and an extended position; said movable head including a movable head body provided with a proximate end and a distal end and at least one tool receiving aperture extending from said proximate end to said distal end;

a movable floor so mounted to said movable head body as to provide a free space between said floor portion and said movable floor;

an impact actuator including an impact actuator body mounted to said bucket body and impact head so mounted to said actuator body as to be selectively movable between a retracted position and an extended position; said impact actuator being mounted in said free space; and

at least one tool configured and sized to be slidably inserted in said at least one tool receiving aperture of said movable head body; when inserted in said at least one tool receiving aperture, said at least one tool being slidable between an extended position and a retracted position where said at least one tool contacts said impact head; wherein said impact head, when in its extended position, (a) contacts said proximate end of said movable head body when said at least one tool is in its extended position and (b) contacts said at least one tool when said at least one tool is in its retracted position.

23. An excavation bucket as recited in claim **22**, further comprising biasing means biasing said movable head body towards said retracted position.

24. An excavation bucket as recited in claim **23**, wherein said biasing means include at least one compression spring.

25. An excavation bucket as recited in claim **22**, further comprising biasing means mounted between said movable head body and said impact head to bias said impact head towards its retracted position.

26. An excavation bucket as recited in claim **25**, wherein said biasing means include at least one compression spring.

27. An excavation bucket as recited in claim **22**, wherein said movable head body also includes a tool locking mechanism to selectively lock said at least one tool in said at least one tool receiving aperture while allowing the sliding movements of said at least one tool between its extended and retracted positions.

28. An excavation bucket as recited in claim **27**, wherein said tool locking mechanism includes a cylindrical rod so mounted to a transversal aperture of said movable head body as to be rotatable between a locking position and an unlocking position; said cylindrical rod including at least one longitudinal channel facing a tangential channel of said at least one tool when said pivot bar in said non locking position.

29. An excavation bucket as recited in claim **22**, wherein said movable head includes means for preventing its extended position to be exceeded.

30. An excavation bucket as recited in claim **29**, wherein said preventing means including means for mounting said movable head body to said bucket body while allowing said movable head body to slide between said retracted and extended positions.

31. An excavation bucket as recited in claim **30**, wherein said mounting means include a mounting rod, transversal oblong apertures of the movable head body and circular apertures of the lateral side portions; said mounting rod being configured and sized to be inserted in the oblong and circular apertures to therefore mount the movable head body to the side portions of the bucket body while allowing longitudinal movements of the movable head body.

32. An excavation bucket as recited in claim **22**, wherein said tool holding assembly includes three tool receiving longitudinal apertures.

33. An excavation bucket as recited in claim **32**, wherein said at least one tool include three teeth releasably mounted to a respective tool receiving aperture.

34. An excavation bucket as recited in claim **22**, wherein said at least one tool includes a clay cutting attachment releasably inserted in said at least one tool receiving aperture.

35. An excavation bucket as recited in claim **22**, wherein said at least one tool includes a root shredding attachment releasably inserted in said at least one tool receiving aperture.

36. An excavation bucket as recited in claim **22**, wherein said at least one tool includes a picket ramming attachment releasably inserted in said at least one tool receiving aperture.

37. An excavation bucket as recited in claim **22**, wherein said at least one tool includes a compaction attachment releasably inserted in said at least one tool receiving aperture.

38. An excavation bucket as recited in claim **22**, wherein said lateral side portions of said bucket body includes internal lateral guides allowing longitudinal movements of said movable floor and preventing other movements of said movable floor.

* * * * *